



NASA Procedural Requirements

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Subject: Facilities Maintenance Management w/ Change 1 (4/21/04)

Responsible Office: Facilities Engineering and Real Property Division

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CHAPTER 9. Backlog of Maintenance and Repair (BMAR)

9.1. Introduction

This chapter discusses the BMAR. See also the related discussions in Chapter 4, Annual Work Plan, and on Facility Condition Assessment (Chapter 10, Facilities Maintenance Standards and Actions). BMAR has become the topic of renewed interest, concern and scrutiny within the highest levels of the Federal Government, including the U.S. Congress, Office of Management and Budget (OMB), Department of Defense and the Department of the Treasury.

9.1.1. Definition. The BMAR also referred to by the Federal Accounting Standards Advisory Board, Standard #6, as "deferred maintenance," is the total of essential, but unfunded facilities maintenance work necessary to bring Centers to the required facilities maintenance standards. It is work that should be accomplished during the year but cannot be accomplished within available resources. It does not include new construction, additions, or modifications. BMAR does include unfunded maintenance requirements, repairs, Replacement of Obsolete Items (ROI) and Construction of Facilities (CoF) repair projects.

9.1.2. BMAR, when applied correctly, can be an excellent overall indicator of the condition of Center facilities and collateral equipment as a group. It reflects the cumulative effects of underfunding facilities maintenance and repair. Review of BMAR trends and comparison of BMAR with the Current Replacement Value (CRV) and facilities maintenance funding provide indications of the adequacy of the resources devoted to facilities maintenance.

9.2. Background

9.2.1. Inadequate funding for maintenance and repair programs throughout the federal government has historically been a standing problem. Agencies' needs have gotten little sympathy from the highest levels of Government for several reasons, including the following:

- a. There is the tacit assumption that maintenance can always be put off for a month, a year, or even five years in favor of current operations with higher visibility and perceived better payback on the investment;
- b. The Federal Government decision making authority for maintenance and repair programs is widely dispersed and is not structured in a manner that properly places accountability and responsibility for the care of facilities on a specific steward;
- c. The relationship of facilities to Agency missions has not been recognized adequately in federal strategic planning and budgeting process;
- d. Definitions and calculations of facilities-related budget items, methodologies for developing budgets, and accounting and reporting systems for tracking and repair expenditures vary. A concern is that inappropriate items have been included in the maintenance backlog to inflate the overall estimate as justification for a higher budget appropriation;
- e. Agencies have not satisfactorily convinced higher authority about the implications of deferral that funds invested

in preventive and timely maintenance will be cost effective, will protect the quality and functionality of the facilities, and will protect the taxpayer's investment.

9.2.2. All of these are indicative of the reasons why good, convincing, standardized and accurate data, presented in an organized and meaningful way, is so important to NASA in obtaining the budget appropriations necessary to maintain its facilities so that they operate adequately and cost effectively, their functionality and quality are preserved, and they provide a safe, healthy productive environment for the people who work and visit them every day. Further, as the steward of the facilities under its custody, NASA and by extension, each Center, has an obligation to the public to realistically and truthfully report its critical unfunded maintenance requirements and impact on mission. The BMAR is the vehicle by which that is done.

9.3. Facility Life Cycle

9.3.1. Most constructed facilities are designed to provide at least a minimum acceptable level of shelter and service for 30 years. With proper management and maintenance, buildings may perform adequately for 40 to 100 years or more and may serve several different functions.

9.3.2. The service life of a facility depends on many factors such as the quality of the building's design, the durability of the construction materials and component systems, the incorporated technology, the location and climate, the use and intensity of use, and damage caused by human error and acts of God. These all influence how well and how quickly a facility ages and the amount of maintenance and repair it requires over its life-cycle. Although a building's performance inevitably declines because of aging, wear and tear and functional changes, its service life can be optimized through adequate and timely maintenance and repairs, as illustrated in Figure 9-1. Conversely, when maintenance and repair activities are continuously deferred, the result can be an irreversible loss of service life.

9.3.3. Facilities that are functionally obsolete, are not needed to support NASA's mission, are not historically significant and are not suitable for transfer or adaptive reuse should be eliminated when it is cost effective to do so.



Figure 9-1. Effect of Adequate and Timely Maintenance and Repairs on the Service Life of a Building (Appendix B, resource 35)

9.4. General Principles

To be credible, the BMAR should be calculated on the basis of a condition assessment of all facilities as follows:

- a. All maintenance deficiencies should be identified and cost-estimated based on a current facilities condition assessment that includes input from continuous inspections.
- b. Deficiencies that will be corrected as part of the current year Annual Work Plan (AWP) must be subtracted from the BMAR.
- c. Deficiencies in facilities that do not support the Center's long-term or near-term mission goals as articulated in the Master Plan are not be included in the BMAR.
- d. The BMAR must be reevaluated annually. This not only authenticates the work that continues to be deferred as BMAR, but it also identifies work items in the BMAR covering deficiencies that have progressed to the point where they absolutely need to be included in the AWP.

9.5. National Research Council (NRC) 2- to 4-percent Guidance

9.5.1. There is no single, agreed upon guideline that determines how much funding is required to adequately maintain facilities. However, in 1990 the National Research Council recommended (Appendix B, resource 35) that, "An appropriate budget allocation for routine Maintenance and Repair (M&R) for a substantial inventory of facilities will typically be in the range of 2- to 4-percent of the aggregate current replacement value of those facilities."

9.5.2. Lacking an actual requirements-driven budget, the annual facilities maintenance budget should average 2- to 4-percent of CRV. (see Figure 2-1.) However, this rule of thumb applies only when the facilities have reached a steady-state maintenance condition (i.e., when the backlog has been reduced to an acceptable level). What an acceptable level is depends upon the nature of the backlog and the mission of the Center. For example, a large backlog for interior painting may be acceptable, while a large backlog of roof repairs may portend serious problems and should be reduced quickly.

9.5.3. Figure 9-2 illustrates the relationship between the backlog and annual maintenance funding levels as a percentage of CRV. It shows also a method of backlog reduction. For illustrative purposes only, Figure 9-2 assumes that 3.5-percent is the optimum steady-

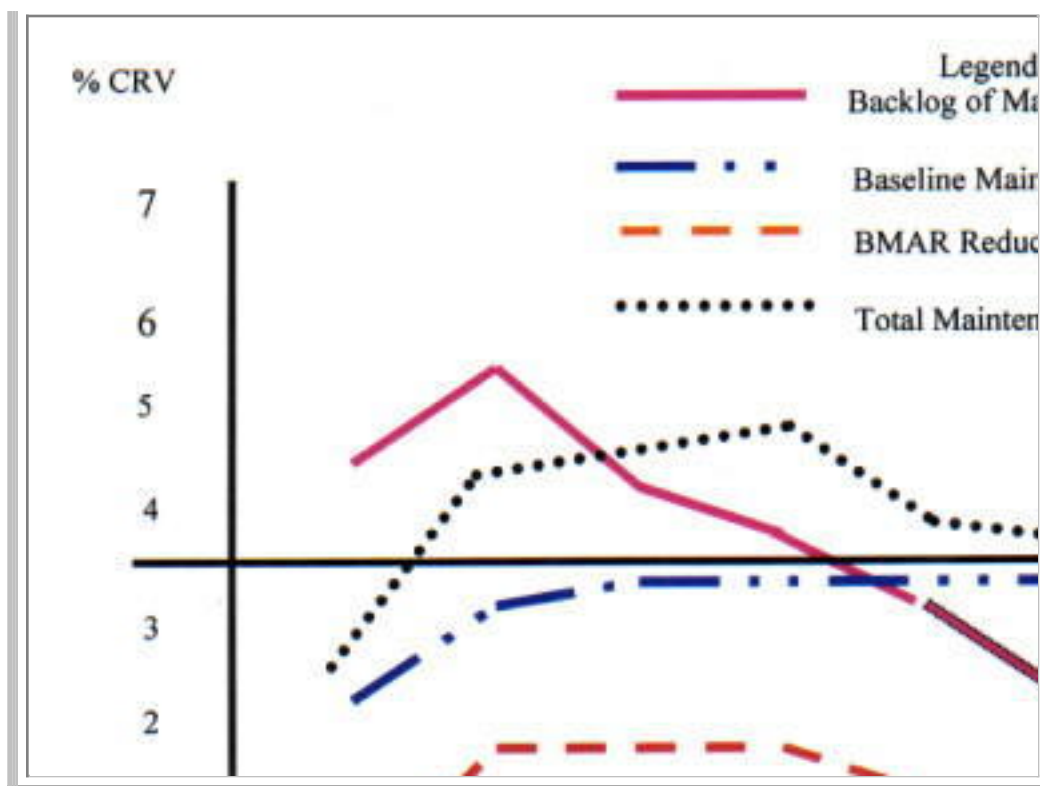


Figure 9-2. Typical BMAR Reduction Funding Profile

state maintenance funding level and that a backlog under 2-percent of CRV is acceptable. In this example, annual maintenance funding initially averages 2-percent of CRV, and the backlog is increasing each year. Then, baseline annual maintenance funding increases to .5 percent over a 2-year period, and additional funding is programmed for backlog reduction over a 6-year period. As the backlog is reduced to below 2-percent of CRV, special funding for backlog reduction decreases, but baseline maintenance funding remains at 3.5 percent. If the backlog begins to increase, maintenance funding should be increased again to reduce the backlog to below 2-percent of the CRV.

9.5.4. Metrics. Evaluation of BMAR and other maintenance performance indicators against a baseline is discussed in paragraph 3.11, Management Indicators, and listed in Appendix F. For example, in ratio 3 of Table 3-3 the trend should be downward, toward the NASA goal of reducing BMAR to a manageable level. An elimination of the BMAR is not always possible or desirable since BMAR can provide an ability to balance resources in the long term. Appendix F lists other metrics of which BMAR is a factor.

9.6. Facilities Condition Assessment (FCA)

9.6.1. See also Chapter 10, Facilities Maintenance Standards and Actions, for more detailed discussion. Maintenance and repair requirements and equipment condition should be determined and validated through the facility condition assessment process. This assessment should be conducted continuously during normal PM and PT&I inspections, observations by the facility manager or other responsible individuals, and other work order repairs. It is important for the FCA process to focus on what is really important - on mission; life, health and safety issues; and on systems most critical to a facility's performance - in order to optimize available resources, provide timely and accurate data for formulating maintenance and repair budgets, and provide critical information for the ongoing management of facilities.

9.6.2. BMAR is a direct product of the FCA. NASA Centers are responsible for identifying and quantifying facility conditions in order to support annual and 5-year Work Plans. The BMAR is the delta between the work requirements identified in the FCA and those that can be satisfied within the funding available. Adoption of the RCM philosophy, PT&I, CMMS, and proactive maintenance approaches provide Centers with information related to facility condition that was not previously available. These new information sources, coupled with increased customer and user input, have the potential to provide valuable FCA data without having to perform many of the discrete inspections required under the traditional FCA processes.

9.6.3. NPD 8831.1 requires that Centers continuously assess facility conditions to identify and quantify their BMAR so as to be 80-percent accurate at any point in time. Since a Center's facilities are in a constant state of change due to normal wear and tear, renewal tasks, and reconfiguration, the FCA process must be dynamic if an accurate estimate of a Center's condition is to be obtained. In order to facilitate this all BMAR should be maintained in the

Center's CMMS in a format that can be updated with the results of the continuous inspection program and with additions to and deletions from the facilities and equipment inventory. The CMMS records should identify BMAR by facility and classify each item as Mission Direct support, Mission Support, or Center Support and further classify each item by the type of work, such as roofs, HVAC systems, structures, roads, or similar system.

9.7. BMAR Reporting

Each Center should develop a customized, written plan explaining how each of the following elements of the BMAR is to be performed. Its purpose is to standardize, organize, document and give credibility to the process.

9.7.1. BMAR Recording. As discussed above, the FCA is to be 80-percent accurate at any point in time. The unfunded requirements compose the BMAR database, which should be an element of the CMMS. As part of the continuous inspection process, the FCA should be periodically updated, and as new unfunded projects are developed to satisfy these deficiencies, they should be added to the BMAR listing in the CMMS. It is also important that key management information, such as facility number, equipment number, condition code, and criticality code, is linked to each BMAR requirement.

9.7.2. BMAR Inspection. FCA inspections are to be conducted on all maintainable facilities, structures, utilities and their collateral equipment on a continuous basis as part of the PM and PT&I inspections. All work orders should have a section where the craftsman can comment on the condition of the item being inspected or worked on. Existing real-time condition information, such as condition code, TC history, downtime information and BMAR information relevant to the equipment being inspected should be available to the craftsman before going to the site. Any changes in the condition (i.e., condition code) following the maintenance or repair action should then be noted as an update to the FCA and CMMS long term database.

9.7.3. BMAR Databases, Computer Systems, and Data Format. The BMAR database can be resident on the CMMS or a database that is linked to the CMMS. The same capability will exist in either case. BMAR projects should be identified as such in the database.

9.7.4. BMAR Costing Methods. A NASA wide cost effective procedure for estimating a Center's BMAR is being developed and will be provided as soon as available. Until a standard NASA method is developed one of the three methods shown in Appendix H may be used. Regardless of the BMAR costing method used, resources should not be expended to prepare engineering type cost estimates since "Ball Park" estimates will suffice.

9.7.5. Annual Changes to the BMAR Program. BMAR projects should be reviewed for currency, accuracy and relative priority at least once per year, prior to submission of the budget and CoF requirements. Once funding levels are determined for the upcoming fiscal year, the remaining projects and usually any new requirements are carried over to the next budget cycle and evaluated for funding for the next fiscal year. As BMAR requirements, including CoF projects, are funded they are to be removed from the unfunded list.

9.7.6. Annual BMAR Cost Updates. BMAR cost estimates are to be updated annually to account for inflation and any changed conditions based on project reviews. The inflation update can be made automatically by the computer.

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